

## Sacramento Valley Groundwater Basin, West Butte Subbasin

- Groundwater Basin Number: 5-21.58
- County: Butte, Glenn, Colusa
- Surface Area: 181,560 acres (284 square miles)

### Basin Boundaries and Hydrology

The portion of the Sacramento Valley Groundwater Basin bounded on the west and south by the Sacramento River, on the north by Big Chico Creek, on the northeast by the Chico Monocline, and on the east by Butte Creek comprises the West Butte Subbasin. Big Chico and Butte Creeks serve as subbasin boundaries in the near surface. The subbasin is hydrologically contiguous with the Vina and East Butte Subbasins at depth. The Chico Monocline forms a geographic boundary; however, a component of recharge to the subbasin appears east of the fault structure. Groundwater flow is southwesterly toward the Sacramento River north of the city of Princeton. South of Princeton, groundwater flows away from the Sacramento River to recharge the groundwater system. Annual precipitation within subbasin is approximately 18 inches in the valley increasing to 27 inches towards the foothills.

### Hydrogeologic Information

#### ***Water-Bearing Formations***

The West Butte aquifer system is comprised of deposits of Late Tertiary to Quaternary age. The Quaternary deposits include the Holocene stream channel deposits and basin deposits, and the Pleistocene Modesto Formation, Riverbank Formation, and Sutter Buttes alluvium. The Tertiary deposits consist of the Pliocene Tehama Formation and the Tuscan Formation.

**Holocene Stream Channel Deposits.** These deposits consist of unconsolidated gravel, sand, silt and clay derived from the erosion, reworking, and deposition of adjacent Quaternary stream terrace alluvial deposits. The thickness varies from 1- to 80-feet (Helley and Harwood 1985). The unit represents the upper part of the unconfined zone of the aquifer and is moderately-to-highly permeable; however, the thickness and areal extent of the deposits limit the water-bearing capability.

**Holocene Basin Deposits.** Basin deposits are the result of sediment-laden floodwaters that rose above the natural levees of streams and rivers to spread across low-lying areas. They consist primarily of silts and clays and may be locally interbedded with stream channel deposits along the Sacramento River. The deposits extend from south of Big Chico Creek to north of Angel Slough. Thickness of the unit can range from 10- to 100-feet (DWR 2001). The deposits have low permeability and generally yield low quantities of water to wells. The quality of groundwater produced from the unit is often poor (USBR 1960).

**Pleistocene Modesto Formation.** The Modesto Formation (deposited between 14,000 to 42,000 years ago) consists of poorly indurated gravel and cobbles with sand, silt, and clay derived from reworking and deposition of

the Tuscan and Riverbank formations. Surface exposures extend south from Big Chico Creek to north of the city of Durham and also extend south of Angel Slough to the Sacramento River. The unit varies in thickness from 50- to 150-feet (DWR 2000). In locations where gravel and sand predominate, groundwater yields are moderate.

**Pleistocene Riverbank Formation.** The Riverbank Formation (deposited between 130,000 and 450,000 years ago) consists of poorly-to-highly permeable pebble and small cobble gravels interlensed with reddish clay sands and silt. The areal extent of the formation is limited more to the southern portion of the subbasin and underlies surface exposures of the Modesto Formation. The thickness of the formation is approximately 1- to 200-feet depending on location (DWR 2000). The formation is moderately to highly permeable and yields moderate quantities of water to domestic and shallow irrigation wells.

**Pleistocene Sutter Buttes Alluvium.** In the southern extents of the subbasin, Sutter Buttes alluvium is observed in the subsurface and may range in thickness up to 600 feet (DWR 2000). These alluvial fan deposits consist largely of gravel, sand, silt and clay and may extend up to 15 miles north of the Sutter Buttes and westerly beyond the Sacramento River. Utility pump test records for wells located east of the subbasin, but believed to be in the same formation, show the average well yield for the formation to be approximately 2300 gallons per minute with an average specific capacity of 64 gpm/ft.

**Pliocene Tehama Formation.** The Tehama Formation consists of sediments originating from the coastal mountains and interfingers with sediments of the Tuscan Formation in the vicinity of the Sacramento River at the far western extent of the subbasin (DWR 2000).

**Pliocene Tuscan Formation.** The Tuscan Formation is composed of a series of volcanic mudflows, tuff breccia, tuffaceous sandstone and volcanic ash layers. Thickness of the formation is estimated to be 800 feet (DWR 2000). The formation is described as four separate but lithologically similar units, A through D (with Unit A being the oldest), which in some areas are separated by layers of thin tuff or ash units (Helley and Harwood 1985). Units A, B, and C are found within the subsurface in the northern part of the subbasin and Units A and B are found in the southern part of the subbasin. Surface exposures of Units A, B, and C are located in the foothills at the far-eastern extents of the subbasin. The surface exposure of Unit B east of the subbasin boundary is a recharge area.

Unit A is the oldest water bearing unit of the formation and is characterized by the presence of metamorphic clasts within interbedded lahars, volcanic conglomerate, volcanic sandstone and siltstone. Unit B is composed of a fairly equal distribution of lahars, tuffaceous sandstone, and conglomerate. Unit B is volcanoclastic and is the most transmissive portion of the volcanic aquifer system and is the primary aquifer at depth. The surface exposure of Unit B, east of the subbasin boundary, is a recharge area. Although the Tuscan Formation is unconfined where it is exposed near the valley margin, at depth, the formation is confined. Unit C consists of massive mudflow or

lahar deposits with some interbedded volcanic conglomerate and sandstone. In the subsurface, these low permeability lahars form thick, confining layers for groundwater contained in the more permeable underlying sediments of Unit B.

### ***Groundwater Level Trends***

Review of the hydrographs for long-term comparison of spring-to-spring groundwater levels indicates a decline in groundwater levels associated with the 1976-77 and 1987-94 droughts, followed by a recovery in groundwater levels to pre-drought conditions of the early-1970s and 1980s. Comparison of spring-to-spring groundwater levels from the 1950's and 1960's, versus today's levels, indicate about a 10-foot decline in groundwater levels in portions of the West Butte Subbasin (DWR 2001).

Areas unaffected by municipal water use reflect the natural groundwater table distribution and direction of movement. Year-round extraction of groundwater for municipal use in the Chico area causes several small groundwater depressions that tend to alter the natural southwesterly movement of groundwater in the area (DWR 2001). In the Chico area, groundwater levels in the unconfined portion of the aquifer system is about 5- to 7-feet during normal precipitation and up to approximately 16 feet during periods of drought. Annual fluctuation in the confined or semi-confined portion of the aquifer system is approximately 15- to 25-feet during normal years and up to approximately 30 feet during periods of drought. Long-term comparison of spring to spring groundwater levels indicates a 10 to 15-foot decline in levels since the 1950's.

### ***Groundwater Storage***

The storage capacity of the subbasin was estimated based on estimates of specific yield for the Sacramento Valley as developed in DWR (1978). Estimates of specific yield, determined on a regional basis, were used to obtain a weighted specific yield conforming to the subbasin boundary. The estimated specific yield for the West Butte Subbasin is 7.7 percent. The estimated storage capacity to a depth of 200 feet is approximately 2,794,330 acre-feet.

### ***Groundwater Budget (Type B)***

Estimates of groundwater extraction for the West Butte Subbasin are based on surveys conducted by the California Department of Water Resources during 1993 and 1997. Surveys included landuse and sources of water. Estimates of groundwater extraction for agricultural; municipal/industrial; and environmental wetland uses are 161,000, 10,000 and 4,600 acre-feet respectively. Deep percolation of applied water is estimated to be 64,000 acre-feet (DWR 2001).

### ***Groundwater Quality***

Characterization. Calcium-magnesium bicarbonate and magnesium-calcium bicarbonate are the predominant groundwater types found in the subbasin. Sodium bicarbonate type waters occur at the southern tip of the subbasin west of Sutter Buttes. Concentrations of total dissolved solids (TDS) range from 130- to 676-mg/L, averaging 293 mg/L (DWR unpublished data).

**Impairments.** Some high nitrates are found in the Chico area. Localized high calcium, conductivity, boron, TDS, and adjusted sodium absorption ratio occur within the subbasin.

### Water Quality in Public Supply Wells

Constituent Group <sup>1</sup>	Number of wells sampled <sup>2</sup>	Number of wells with a concentration above an MCL <sup>3</sup>
Inorganics – Primary	29	0
Radiological	25	0
Nitrates	30	0
Pesticides	26	0
VOCs and SVOCs	26	1
Inorganics – Secondary	29	2

<sup>1</sup> A description of each member in the constituent groups and a generalized discussion of the relevance of these groups are included in *California's Groundwater – Bulletin 118* by DWR (2003).

<sup>2</sup> Represents distinct number of wells sampled as required under DHS Title 22 program from 1994 through 2000.

<sup>3</sup> Each well reported with a concentration above an MCL was confirmed with a second detection above an MCL. This information is intended as an indicator of the types of activities that cause contamination in a given basin. It represents the water quality at the sample location. It does not indicate the water quality delivered to the consumer. More detailed drinking water quality information can be obtained from the local water purveyor and its annual Consumer Confidence Report.

### Well Production characteristics

Well yields (gal/min)		
Irrigation	Range: 7 – 4000	Average: 1833 (46 Well Completion Reports)
Total depths (ft)		
Domestic	Range: 15 – 680	Average: 136 (1469 Well Completion Reports)
Irrigation	Range: 40 - 920	Average: 321 (1038 Well Completion Reports)

### Active Monitoring Data

Agency	Parameter	Number of wells /measurement frequency
DWR	Groundwater levels	32 wells semi-annually
DWR	Miscellaneous water quality	8 wells biennially
Department of Health Services and cooperators	Miscellaneous water quality	36

## Basin Management

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Groundwater management: Butte County adopted a groundwater management ordinance in 1996.  
Glenn County adopted a groundwater management ordinance in 2000.  
Colusa County adopted a groundwater management ordinance in 1998.

### Water agencies

Public Butte Basin Water Users Association, Buzztail Community Service District, Durham ID, City of Chico, RD 1004, Western Canal WD, M&T Chico Ranch Inc., Sartain MWC

Private Dayton Mutual Water Company, Del Oro Water Company, Durham Mutual Water Company and California Water Service

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## Errata

Changes made to the basin description will be noted here.